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THE PRINCIPLES OF FACILITIES MANAGEMENT AND CASE STUDIES

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Abstract: This paper presents a set of six principles of facilities management (FM) with supporting discussion through selected case studies to justify these principles, which were put forward through a rigorous quantitative analysis through a TRIZ process underpinned by extensive literature review into industry standards, professional guidance and best practice relating to FM. The six principles covers three essential technical domains including Clients and Professionals, Service Products, and Service Processes to reflect six important aspects that forms the entire contemporary FM practice. For the domain on Clients and Professionals, this paper highlights technical focuses on providing competitive advantage for clients and developing professional competence through lean practice. For the domain on Service Products, this paper emphasises key issues on the dependability driven quality services and sustainability oriented resources efficiency. For the domain on Service Processes, this paper enhances technical needs for effective services procurement and provision and lifecycle oriented rapid dynamic responses. The nine-square approach as a TRIZ process was adopted to conduct a holistic review into literatures and practice relating to FM, and this also provides a novel practical approach to inform further research into construction management. In order to further justify the relevance and value of the six FM principles, this paper also provides a series of case studies which address how these principle can be applied to advance FM practice with regard to improving professional leadership and technical capability in the provision of FM services across industry sectors towards dependable and sustainable built environment.

Keywords: buildings, case studies, facilities management, principles, TRIZ.

INTRODUCTION

This paper is a summary of the author's recent research into the principles of facilities management (FM). With regard to the background that there was a lack of summary of FM principles despite of some initiatives led by professional bodies including RICS (2012) and ICE (2013), this research was set up at philosophy level to derive a reliable set of FM principles based on the framework of FM body of knowledge (FMBOK) accumulated through professional practice and research in the subject field over the past three decades.

This research was conducted through the use of an extensive literature review underpinned by TRIZ (Gadd, 2011) in order to identify the principles of FM through an inventive process towards a reliable and innovative summary to inform further practice and research. In addition, case studies were further conducted and presented in this paper to justify those FM principles with regard to their relevance and applicability in practice.

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This paper describes the research in three parts, including the use of TRIZ, principles of FM, and case studies. It demonstrates how TRIZ has facilitated an inventive problem solving process to derive the principles of FM in this research, and this, as a new example, can also inform the learned society with regard to the value of using TRIZ in innovative research. The author expects that this paper with regard to the theoretical progress in the subject field could be useful for both practice and further research in FM.

THE USE OF TRIZ

TRIZ is the Russian acronym for "Teoriya Resheniya Izobretatelskikh Zadatch", which means the 'Theory of Inventive Problem Solving' and was developed in 1946 by soviet inventor Genrich Altshuller and his colleagues (Gadd, 2011), and it has been widely received and applied in the creative sector and some other sectors. The author of this paper has applied the theory of TRIZ in his research into the sustainable built environment in the past decade, and one example is to integrate TRIZ with an analytic network process (ANP) for multicriteria assessment of façade systems with regard to the whole life value of the design (Chen, et al., 2007). According to a recent research by Renev and Chechurin (2016) only found 28 scientific works on the application of TRIZ in the building industry, and this reveals that TRIZ usage in construction management is still quite limited. It is therefore important to explore more applications of TRIZ towards innovative solutions in construction.

In the field of FM, it has been not only of academic interest in but also professional need for a set of principles to support best practice research and development after a fast profession growth in this new sector in the past three decades. In order to derive a reliable set of principles of FM through an extensive review on literature and practice, as well as to verify the suitability of those principles with regard to their applicability in specific practice and further research, the TRIZ was chosen to effectively facilitate an expected inventive process. For such a dedicated research, the author of this paper adopted the nine-square approach, which is one practical TRIZ tool, to qualitatively identify and justify the framework of FMBOK and the set of FM principles.

Figure 1 illustrates the nine-squares that were named and used to derive the FMBOK framework and FM principles described in this paper. In principle, the nine-square approach looks on the horizontal direction into the history, the present, and the future of the problem to be solved through a review into related information at both microcosmic and macroscopic level across the vertical direction. Based on the theory of the nine-square approach, Figure 1 presents an evolutionary process to derive the terminal goal through a middle square which collects all feedback from the rest of seven squares. As illustrated in Figure 1, the square of FM Principles was set up as the goal of this nine-square analytic process and achieved through the establishment of FMBOK in the middle square to collect feedback from the following seven squares for review on:

- The principles of management in academia domain with regard to theoretical achievement of management principles that can underpin and inform the summary of principles of FM.
- FM definition and practice in practice domain with regard to evolving FM practice that can inform the summary of FM principles by providing a comprehensive connection between theory and practice.

- International practice in FM in practice domain with regard to the best practice in FM that can inform the summary of FM principles by incorporating the best practice at international level to inform future FM practice in a wide scope across the whole FM sector.
- FM core principles defined by RICS with regard to professionally recognised FM principles to inform the summary of FM principles towards a better expression underpinned by further considerations on theory and practice in related areas.
- The principles of project management such as standards developed by BSI with regard to accumulated knowledge on project management relating to FM at macro-system level.
- FM standards being developed by BSI with regard to contemporary professional standards on quality FM services at macro-system level.
- ISO FM standards being led by BSI with regard to international professional standards on quality FM services at macro-system level.

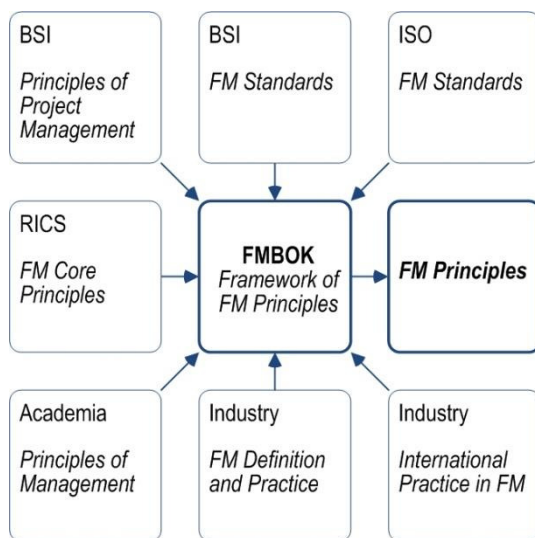


Figure 1: A TRIZ approach to deriving FMBOK framework and FM principles

The review through these seven squares was expected to ensure a systematic study on FMBOK from the past through present to the future at three main levels on micro-system, system, and macro-system in the scope of FM related practice and research. In this research, the nine-square approach illustrated in Figure 1 was used to derive the framework of FMBOK first and then a set of principles of FM.

For the framework of FMBOK, this research has identified five knowledge domains through TRIZ driven literature review, including FM Philosophy (Cairns, 2003), FM Profession (Clients and Professionals) (Elmualim, et al., 2010), FM Products (Service Products) (Chotipanich, 2004), FM Processes (Service Processes) (Christian and Daniel, 2014), and FM Practice (Price and Akhlaghi, 1999). A further justification was conducted to identify technical contents on these knowledge domains from key literatures such as the book on total FM by Atkin and Brooks (2009 and 2015), and the series of FM related standards published by British Standards Institution (BSI) since 1986.

PRINCIPLES OF FM

The book on the Principles of Scientific Management (Taylor, 1911) has profound influence to the evolving theory of management science over the past ten decades. According to Jones and George (2012), the management theory has evolved from the scientific management theory in the 1880s and 1890s through the development of administrative management theory, behavioural management theory, management science theory and organizational environmental theory towards the theoretical system of contemporary management. In the past several decades, the revolution of integrated lifecycle management of built assets has made the FM one of the most fast-growing profession in the global construction industry with regard to clients' diverse needs and demands, and the formation of FM principles has been eventually in need for theory development for both research and practice for this profession.

The concept of total FM (Atkin and Brooks, 2009 and 2015) has not only been adopted in practice, at Mitie for example, but also inspired management thought on three essential elements, including people, products and processes, to structure the FMBOK so as to derive a set of principles of FM. From the FM profession point of view, people are clients and FM professionals and their organisations, products are various FM services, and processes are various management actions to provide FM services. A further review focused on people, products and processes was therefore conducted into the evolution of management theory to set up a generic framework of management principles for FM. After looking into five major management theories summarised by Jones and George (2012), it has been found that the three essential elements as a whole set of essential elements of FM are well connected with key aspects inside the five management theories (Refer to Figure 2) in terms of their coverage to all general management issues. This review process was conducted in the first square on the principles of management in academia domain (Refer to Figure 1) and formed the essential structure of the FMBOK framework and eventually the technical domains for FM principles.

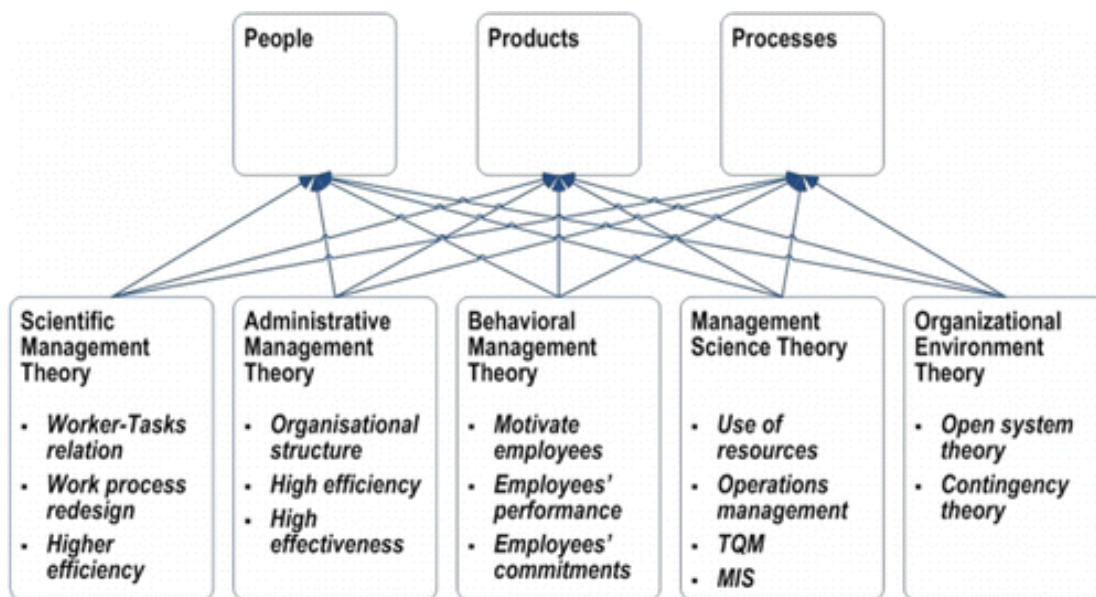


Figure 2: Interconnections between management theories and FMBOK knowledge domains

With regard to the relevance of these essential elements to structure, the FMBOK, a further review into the following three related documents and other publications, including A Practical Guide to Facilities Management (Barker, 2013), has provided strong justification:

- BS 6079-1:2010 Project management – Principles and guidelines for the management of projects (BSI, 2010),
- RICS facilities management standards – core principles (RICS, 2012), and
- ICE’s Guiding Principles of Asset Management (ICE, 2013).

Generally speaking, the best practice in FM can satisfy two essential needs on dependability and sustainability. Dependability consists of issues about conditions of built assets and related FM services in terms of reliability, maintainability, supportability and adaptability. Sustainability includes all aspects of FM in relation to social, technical, economic, ecological and political issues. Based on needs for both dependability and sustainability in FM, and a comprehensive review and technical analysis into related literatures and practice through the nine-square approach (Refer to Figure 1), a set of six general principles of FM were summarised within the FMBOK framework structure. For the knowledge domain on people (Clients and FM professionals), it emphasises professional competence and lean organisation. For the knowledge domain on products (FM service products), it emphasises quality services and resources efficiency. For the knowledge domain on processes (FM service processes), it emphasises effective actions and dynamic responses. Table 2 provides a summary of the six FM principles that have been derived from the research.

Table 2: Six principles of FM

Knowledge Domains	Principles of FM
Clients and Professionals	1. Competitive advantage for clients 2. Professional competence through lean practice
Service Products	3. Dependability driven quality services 4. Sustainability oriented resources efficiency
Service Processes	5. Effective services procurement and provision 6. Lifecycle oriented rapid dynamic responses

In comparison with RICS draft FM standards about core principles for FM Surveyors (RICS, 2012), which consists of ten pre-contract principles, twelve principles for contract operation and two principles for contract completion, the six principles (Refer to Table 2) derived through the TRIZ process are within a new FMBOK framework which is structured on all three essential elements of management theory in a holistic connection with the nature of FM. It is therefore anticipated that the six principles of FM can demonstrate a good applicability in practice.

CASE STUDIES

This section aims to discuss lessons learnt through case studies in relation to the six identified FM principles in Table 2 regarding their applicability in practice. Due the length limitation of this paper, six cases for study were collected here, as shown in Table 3, from UK over the author's observation on FM practice over the past decade.

Table 3: Six cases



Photo 1: The great natural light, Edinburgh, 2012.



Photo 2: Replacement of brand-new windows, Edinburgh, 2016.



Photo 3: Reliability of thermal insulation, London, 2006.



Photo 4: Display Energy Certificates, London, 2016.



Photo 5: Cash is spent, England, 2008.



Photo 6: Six windows, Edinburgh, 2016.

Competitive advantage for clients

It is essential for FM to effectively support the core business of clients no matter what the mode of services provision could be in either short or longer term. From this point of view, clients need to choose dependable FM services providers who can demonstrate technical advantages that they can bring to clients through professional teamwork with regard to a better value for money in the competitive FM market. This principle therefore aims to reflect clients' needs for FM and the value added FM services to support their core businesses.

Photo 1 was taken from an office building in Edinburgh while all lights in the communal area were unnecessarily left on at the lunch time in the sunny day on 9 October 2012. It has been always a priority to maximise the use of natural light at workplaces not only in building design but also throughout the use of the building. While timers are widely adopted to minimise the intervention because of human factors, there are still problems on the optimised use of lighting in office buildings. With regard to all specifications and regulations of the building, a service level agreement (SLA) can be specifically designed and effectively used to reduce wastes in resources use at workplaces with regard to the advantage for clients through the use of FM services; and from the clients' point of view, the provision of either in-house or outsourced FM services through the implementation of SLAs needs to show such advantages at a competitive level in comparison with other services providers on the local market. In this particular case, the waste on electricity usage indicated a lack of demonstration on the competitive advantage of resource use and the principle on competitive advantage for clients therefore make it relevant in FM practice.

Professional competence through lean practice

The fast growth of the FM profession in the past three decades has been underpinned by the competence of FM professionals working on various positions within companies driven by lean principles for improved efficiency on resources usage at clients' organisations. This principle reflects the requirements on FM professionals in terms of their competencies and organisations in services provision, and it aims to ensure FM services provision in a competitive professional way from design through construction/refurbishment to operation.

Photo 2 was taken on site at the new office building in Edinburgh on 20 January 2016. More than 90 brand-new opening windows were taken away from the building under construction and to be replaced by new ones with different colour of the glass. The changing need/requirement on the client side has added extra cost of the building at not only construction stage due to the rework on those windows but also probably operation stage due to the impacts on construction quality due to this rework. It's an example regarding the role of FM professionals to effectively coordinate building design, construction and use for the benefits of clients in short and longer term. Although it is not unusual for clients to change minds during either design or construction, FM professionals working for clients can actually provide sufficient support to decision making in time among foreseen options.

Dependability driven quality services

This principle aims to ensure clients to have and professionals to provide quality services with regard to the dependability of FM in terms of the built environment and the services. Dependability is the ability of an item to perform as and when required (BSI, 2014), and it is used as a collective term for the time-related quality characteristics of an item in terms of its adaptability, availability, buildability, constructability, durability, integrity, maintainability, recoverability, reliability, safety, security, and supportability. For the built environment, the dependability is essential for clients' business in longer term, and FM services providers therefore need to embed it in services provision with regard to quality standards on physical built assets through whole life.

Photo 3 was taken outside the construction site of one new office building in London on 14 March 2006. Construction quality has direct impacts to the performance of buildings in long term. An example of poor construction in thermal insulation has left

problems which is different from the design scenario. The principle on the dependability driven quality services made an alert on the high-impact contribution of FM at both design and construction/refurbishment stage regarding the relevance of construction quality to FM in longer term.

Sustainability oriented resources efficiency

This principle aims to ensure clients to have and professionals to provide FM services that make the efficiency of resources usage as a goal within the scope of sustainable built environment. In order to achieve such an ambitious goal on long-term resources efficiency towards sustainability, plans on resources usage and implementation have demonstrated their effectiveness in numerous cases, and proved the applicability of this principle in FM practice.

As one essential FM service through longer term, the measurement on energy efficiency has been widely adopted in buildings across the world. For example, large public sector buildings have been required to display the display energy certificate (DEC) in UK since 2008, and the HM Government first published the Guidance about the regulations for DEC of public buildings in 2012, and provided update versions in 2013 and 2015 in order to improve the energy efficiency of public buildings.

Photo 4 was taken at the British Library on 22 July 2016. At the main entrance of British Library, a DEC issued by the HM Government, and an energy label issued by the International Association of Museum Facility Administrators (IAMFA) were put together into a steel frame. This display not only tells people the result from implementing the Energy Action Plan led by the Estates Department but also may have well informed and inspired many library users coming from all over the world regarding the reduction on energy use inside not only the British Library building but also numerous other buildings. On the two displayed certificates (See Photo 4), it can be learned that the British Library had greatly improved its Operational Rating, moving from a score of 152 (G Rating) to a score of 116 (E Rating); and that has been achieved through the implementation of Energy Action Plan including the replacement of the heating and hot water systems with new, highly efficient gas boilers and the introduction of new, very low energy LED lighting in public areas. The best practice on the continuous improvement of energy efficiency at British Library over the past decade has demonstrated the applicability of the principle on sustainability oriented resources efficiency.

Effective services procurement and provision

This principle aims to ensure clients to have and professionals to provide FM services that can be effectively procured and provided in a symmetrical manner with regard to essential FM functions relating to people and products.

There are numerous cases in which resources unnecessarily used at workplaces including open spaces such as car parks, squares and roads within an organisation's local built environment. For example, a lack of informed control on effective energy used for lighting at daytime. The environmentally considerate procurement (Ferro, 2011) of FM services under either in-house or outsourcing mode takes an important role to identify the most appropriate FM contractor upon the adoption of a well-designed SLA and the implementation of a portfolio-based facilities management (NAS, 2011) towards long-term efficiency in resources usage at workplaces. Photo 5 was taken at one railway station in England on 9 June 2008. Like many other railway stations, it looks that timer might be adjusted properly to maximise the use of daylight

on platforms in the summer season. Under the circumstance in which outsourcing has been on an increasing trend in FM, the principle on effective services procurement and provision can be useful for clients to find appropriate services providers and for FM professionals to fulfil their duties.

Lifecycle oriented rapid dynamic responses

The need for and value of professional FM services are to support clients to provide quality workplaces to their employees who may have diverse and dynamic perceptions and needs for everyday working towards productive contributions in teamwork inside the environment where all aspects of health, safety and welfare are sufficiently considered. This principle aims to ensure clients to have and professionals to provide FM services that can effectively and efficiently respond to dynamic needs for facilities and their users inside the local built environment through whole life with regard to essential FM functions relating to people and products.

Photo 6 was taken on campus at one university in Edinburgh at a bright midday on 20 January 2016, and it was a reflection as an example of the quality of light in relation to the provision of lighting and users' preferences at workplaces, in addition to the care of indoor air quality behind the six windows. While it may not be necessarily on demand for a routine check on lighting and indoor air quality at specific time intervals in this office building, Photo 6 shows different lighting degrees in six rooms in which natural and artificial lighting were chosen differently by six academics working in their individual offices. In addition to the lighting, one window on the ground floor was kept open for fresh air while all other five windows were closed in this building which has no artificial ventilation and air conditioning system for offices. It can be learned from Photo 6 that under the circumstances that building occupiers may have different perceptions and/or cautiousness on the conditions of workplaces with regard to essential requirements on health, safety, and wellbeing, etc., it is required that FM can provide thorough care of people and workplaces on these issues through rapid dynamic responses informed by data, information, and knowledge accumulated from specific workplaces under FM, and the applicability of this principle is inevitable.

CONCLUSIONS

This paper summarises the methodology of and findings from a recent research into FM principles. It clarifies the use of TRIZ as a method to derive a set of FM principles, and uses further literature review and case studies to justify the applicability of derived FM principles. The section on TRIZ summarised a nine-square approach to conducting TRIZ-led literature review, which has been used to derive the framework of FMBOK and principles of FM, and can be further widely used as a generic method for extensive literature review in a systematic way in order to justify research aims and objectives. The section on FM principles summarised six generic principles under three knowledge domains on people, products, and processes respectively within the framework of FMBOK. The six FM principles were derived from and justified by the TRIZ-led literature review. The section on case studies provided six exemplary studies on issues related to individual FM principles, and were used to further justify the applicability of the six FM principles. It is expected that research methodology and findings described in this paper could be useful for both practice and research in FM.

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